PATENT SPECIFICATION

739,896

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COMPLETE SPECIFICATION

Improvements in and relating to Fluid-Cooled Dynamo-Electric Machines

We, GENERAL ELECTRIC COMPANY, a Corporation of the State of New York, United States of America, Schenectady 5, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to dynamo-electric machines including a cooling means.

In dynamo-electric machines having totally enclosed casings so that they may be used in locations where it is desirable that there be no communication between the interior of the machine and the surrounding air as, for example, where they are operated in an atmosphere containing dust, water, acids, gases, lint or other particles which will adhere to the surfaces of the motor and decrease the effectiveness of the cooling of the motor, it is difficult to dissipate the heat generated so as to keep the machine temperature within required limits.

The invention aims at an improved cooling means for dynamo-electric machines which is particularly suitable for such machines of the totally enclosed type yet does not require changes in the simple design of the conductors, insulation or iron cores of the machines, and is economical and efficient.

Accordingly this invention resides in a fluid cooled dynamo-electric machine having a tubing provided for containing a coolant which carries loss heat away from inside a housing of the machine, said tubing being flexible, arranged in the space between the said housing and the stator of the machine, in heat transfer contact with the stator or its winding and having its ends tightly sealed in coupling members which are secured to the housing and have their mouth openings outside the housing.

Further details will become apparent and the invention will be better understood from the following description referring to the accompanying drawing, in which:—

Fig. 1 is a side elevational view of a totally enclosed dynamo-electric machine embodying the invention, partly broken away to more clearly illustrate the construction;

Fig. 2 is an end view of the embodiment shown in Fig. 1 with the end shield removed;

Fig. 3 is a side elevational view of a dynamo-electric machine embodying a modification of the invention, partly broken away to illustrate more clearly this construction;

Fig. 4 is an end view of the modification of Fig. 3;

Fig. 5 is an enlarged fragmentary sectional view illustrating another modification of the invention; and

Fig. 6 is a fragmentary sectional view showing the coupling element construction of the invention.

In accordance with one aspect of the invention, a continuous tube through which a suitable fluid coolant, as for example water, may be circulated, and which is preferably formed of a flexible insulating material, has one end connected to a coupling element extending through the motor casing and is wrapped around the overhanging end turns of the stator winding at each end of the stator before being connected to another coupling unit extending through the motor casing. Since the turns of tubing are formed of insulating material, they may be placed in direct contact with the end turns to provide the most effective transfer of heat and, in this arrangement, the end turns require no special insulation to prevent the tubing from short circuiting them. These turns of tubing may be tied to the stator windings by cording or secured thereto by such means as dipping into a varnish or shellac or by heating them slightly to partially

[*Price 3s. 0d.*]

melt the tubing to fuse them to the stator winding end turns. One modification of the invention relates to the placing of additional turns of tubing about the various stator supporting lugs in direct contact with the stator core to assist in carrying away the heat from the stator core.

Referring to the drawing, we have shown the invention in connection with a totally enclosed dynamo-electric machine. The stationary member of this machine includes a laminated core structure 10 having windings with overhanging end turns 11. The machine is enclosed by a cylindrical housing 12 having end shields 13 of usual construction bolted thereto as at 14. Any suitable rotor 9 for the machine mounted on a shaft 8 journalled in end shields 13 may be provided.

In order to prevent an undesirable temperature rise in the motor, we provide the following construction. A continuous tube 15 having one end 16 connected to coupling member 17*a* which will hereinafter be more fully described and which extends through the motor housing 12. Coupling member 17*a* is secured by means of suitable screws 18 to cylindrical casing 12. Tubing 15 is wound in a plurality of helical turns 19 about the outer diameter of the overhanging end turns 11 of the stator winding and are preferably secured thereto by means of ties 20. Since turns 19 are in direct and intimate contact with the overhanging end turns 11 and because the flexibility of the tubing permits it to conform to the irregularities of the outer periphery of the end turns, heat is conducted directly from the winding end turns to the tubing over a relatively large area. After tubing 15 is wound around one end of the stator windings it passes through the space 22 between adjacent lugs 21 which secure the stator 10 to the housing 12. It is then spiralled around the winding end turns at the other end of the motor in direct contact with said end turns as indicated at 23 from whence it is connected to coupling member 17*b*.

While we prefer to make the tubing 15 of a plastic or other flexible insulating material because such material can easily and automatically conform to the uneven contour of the windings, it may be made of copper or other metal coated with an insulating material. It is important that tubing 15 be closely wound about the end turns 11 to assure contact therewith to promote the greatest amount of heat transfer between the windings and the tubing. Further, while we prefer to use continuous tubing having no internal connections which are possible sources of leakage failures, it is apparent that tubing 15 could be made in a plurality of sections.

The machine is installed by connecting coupling elements 17*a* and 17*b* to a source of fluid coolant, which may be any suitable liquid such as water or any suitable gas such as air. The coolant may be circulated through the tubing 15 by any desired means.

It will be seen that this construction provides cooling coils presenting a relatively large cooling surface in contact with the coil end turns and that because the tubing has thin walls the continuous flow of cooling fluid through the tubing will absorb and carry away a large amount of heat from the interior of the motor.

Figs. 3 and 4 illustrate a modification of the invention in which like parts are identified by like numerals indicated for Figs. 1 and 2 and in which the continuous tubing 15 in addition to being wrapped around the winding end turns, is also wrapped around the lugs 21*a* of the stator core in a flat pancake form directly in contact with the iron core of the stator. In this way these coils assist in carrying heat away from the stator laminations directly. Using this form of the invention, we prefer to assemble the tubing 15 on the end turns and over the stator supporting lugs 21*a* prior to inserting the stator and its winding into the stator housing 12. To accomplish this, we prefer to make lugs 21*a* integral with the stator laminations 10.

Fig. 5 illustrates a modification of the invention wherein we secure the spiral coils of plastic to the winding end turns by heating the assembly after the tubing is spiralled around the winding end turns 11 to cause the fusion of the plastic tubing to the windings and to the adjacent turns of tubing. As shown in the modification of Fig. 5, the heating of the plastic tubing results in a slight flattening of the surface of the tubing adjacent the windings to increase the area of contact between the windings and the tubing. It is, of course, possible instead of heating the tubing to fuse the plastic material, to dip the completed stator with the tubing installed in a varnish, of a known kind to secure the individual turns of the tubing together and to secure them to the windings.

As further illustrated in Fig. 5, additional layers 25 of tubing may be used to increase the cooling capacity of the invention to obtain any desired amount.

Fig. 6 illustrates the construction of the coupling element of the invention. A boss 30 is formed on the housing 12. Coupling element base 31 is adapted to be seated on boss 30 and secured thereto by screws 18. The inner bore 33 of the coupling element is provided with a tapered seat 34 at its inner end. Tubing 15 is inserted into the inner end of inner bore 33 and a centrally

apertured clamp screw 35 is threaded into the outer end of the coupling element. Clamp screw 35 is provided with a tapered end 36 which co-operates with tapered seat 34 to clamp and seal the end of tubing 15 to the coupling element. Sleeving 37 may be provided to reinforce tubing 15 if desired. The outer threaded end 38 is adapted to receive a standard fitting of the external fluid supply. It will be apparent that this coupling element construction eliminates the leakage failures encountered by the possible braking of the seal between the coupling element and tubing 15 when the machine is connected to the coolant lines by making the seal between the coupling element and the tubing independent of any stress when the coolant lines are connected. This construction and the absence of internal tubing joints serve to substantially eliminate fluid leakage failures.

What we claim is:—

1. A fluid cooled dynamo-electric machine having tubing provided for containing a coolant which carries loss heat away from inside a housing of the machine, said tubing being flexible, arranged in the space between the said housing and the stator of the machine, in heat transfer contact with the stator or its winding and having its ends tightly sealed in coupling members which are secured to the housing and have their mouth openings outside the housing.

2. A machine as claimed in claim 1, wherein the tubing is made of a synthetic plastic material.

3. A machine as claimed in claim 1, wherein the tubing is of metal, copper for instance, and is preferably coated with a layer of electrically insulating material.

4. A machine as claimed in claim 1, wherein the tubing is wound around the ends of the winding turns which overhang the stator core at either end of the machine, and forms coils which are coaxial with the stator.

5. A machine as claimed in claim 4, wherein the tubing coils are secured to the stator winding by means of ties.

6. A machine as claimed in claim 4, wherein the tubing forms additional coils of pancake shape disposed between the stator core and the housing.

7. A machine as claimed in claim 4 or claim 6, wherein the tubing is made of thermo-plastic material and the walls of the turns of the coils are fused together and to the surface of the overhanging windings.

8. A machine as claimed in claim 6, wherein the additional coils are wound around lugs which space the stator core from the housing.

9. A method of making a machine as claimed in claim 8 wherein the lugs and stator laminations are manufactured to be integral, and the pancake coils are wound around the lugs prior to inserting the stator into its housing.

10. A machine as claimed in claim 1 wherein the individual turns of the coils of the tubing and the electrical winding of the stator are secured together by a binder.

11. A machine as claimed in claim 1 which is totally enclosed by its housing.

12. A machine as claimed in claim 1 wherein the housing has bosses to which the coupling elements are fastened. by screws, for instance.

13. A fluid cooled dynamo-electric machine substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

Agent for the Applicants,
J. W. RIDDING,
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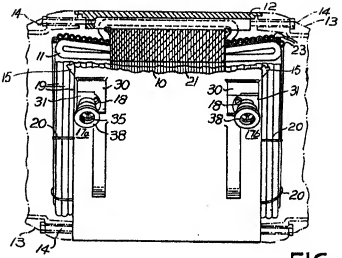

FIG. 1.

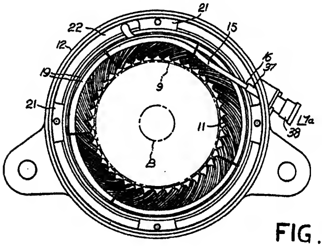

FIG. 2.

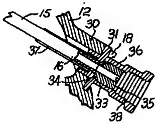

FIG. 6.

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SHEETS 1 & 2

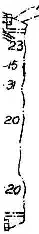

FIG. 1.

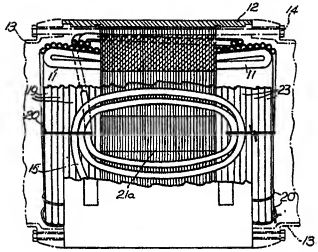

FIG.3.

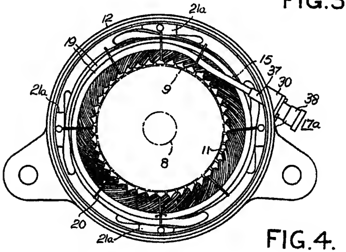

FIG.4.

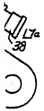

FIG.2.

.6.

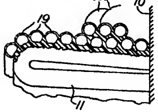

FIG.5

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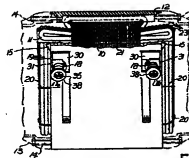

FIG. 1.

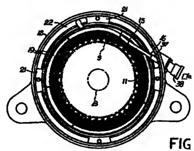

FIG. 2.

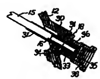

FIG. 6.

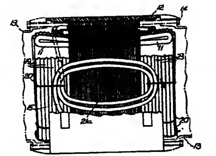

FIG. 3.

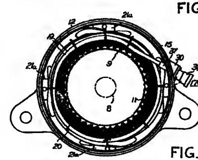

FIG. 4.

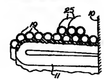

FIG. 5